



# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)  
Dundigal, Hyderabad-500043

## CIVIL ENGINEERING TUTORIAL QUESTION BANK

Course Title	WATER RESOURCES ENGINEERING		
Course Code	ACE014		
Programme	B.Tech		
Semester	VI	CE	
Course Type	Core		
Regulation	IARE - R16		
Course Structure	Theory		
	Lectures	Tutorials	Credits
	3	1	4
Chief Coordinator	Mrs. B. Bhavani, Assistant Professor		
Course Faculty	Mrs. N. Sri Ramya, Assistant Professor Mrs. B. Bhavani, Assistant Professor		

### COURSE OBJECTIVES:

The course should enable the students to:	
I	Enrich the knowledge of hydrology that deals with the occurrence, distribution and movement of water on the earth.
II	Design unlined and lined irrigation canals; mitigate sediment problems associated with canal.
III	Identifying, formulating and management of water resource related issues.
IV	Discuss the limitations and applications of hydrograph flood analysis.

### COURSE OUTCOMES (COs):

CO 1	Understand the basic knowledge of hydrology, hydrological cycle, precipitation and movement of water on earth and below the earth surface in addition to importance and estimation of runoff.
CO 2	Determining the importance of different types of hydrographs.
CO 3	Importance and occurrence of Ground water, estimation of discharge through various types of aquifers, well development.
CO 4	Analyze the importance of irrigation and their types, methods of application of irrigation water, duty and delta, irrigation efficiencies, water logging.
CO 5	Understand the classification of canals, design of irrigation canals, IS standards for a canal design canal lining; SCS curve number method, flood frequency analysis of stream flow.

## COURSE LEARNING OUTCOMES (CLOs):

ACE014.01	Understand the basic concepts of Hydrology and its applications. And also understand different forms and types of precipitation.
ACE014.02	Understand the Rainfall measurement methods and different types of Rain gauges
ACE014.03	Compute the average rainfall over a basin, processing of rainfall data, and adjustment of rainfall record and usage of double mass curve.
ACE014.04	Understand the concepts of runoff, factors affecting runoff, runoff over a catchment, empirical and rational formulae.
ACE014.05	Understand the abstraction from rainfall, evaporation, factors affecting evaporation, measurement of evaporation, evapo-transpiration, pan and Blaney-Criddle methods and infiltration
ACE014.06	Understand the concept of Hydrograph, effective rainfall, and base flow separation
ACE014.07	Analyze the concept of direct runoff hydrograph
ACE014.08	Analyze the importance of unit hydrograph, definition, and limitations applications of unit hydrograph.
ACE014.09	Understand the derivation of unit hydrograph from direct runoff hydrograph and runoff hydrograph to unit hydrograph
ACE014.10	Understand the concept of synthetic unit hydrograph and its applications.
ACE014.11	Understand the Ground water Occurrence and types of aquifers
ACE014.12	Define and understand the different terminology of water resource engineering like aquifer parameters, porosity, specific yield, permeability, and Transmissivity.
ACE014.13	Determine the radial flow to wells in confined and unconfined aquifers
ACE014.14	Understand the concept of Darcy's law in aquifers
ACE014.15	Understand the Types of wells, well construction, and well development.
ACE014.16	Understand the work necessity and importance of irrigation, advantages and ill effects of irrigation, types of irrigation
ACE014.17	Explain the methods of application of irrigation water and understand the India agricultural soils, methods of improving soil fertility, crop rotation, and preparation of land for irrigation
ACE014.18	Understand the standards of quality for irrigation water, soil, water, plant relationship, vertical distribution of soil moisture, soil moisture constants.
ACE014.19	Calculate the soil moisture tension, consumptive use, duty and delta and understand the factors affecting duty.
ACE014.20	Determination of design discharge for a water course. Depth and frequency of irrigation, irrigation efficiencies, water logging
ACE014.21	Understand the mechanical classification of canals
ACE014.22	Design of irrigation canals by Kennedy's and Lacey's theories, balancing depth of cutting
ACE014.23	Calculate by using IS standards for a canal design canal lining. Design discharge over a catchment, computation of design discharge, rational formula.
ACE014.24	Understand the SCS curve number method and flood frequency analysis of stream flow

**TUTORIAL QUESTION BANK**

**UNIT-I**

**INTRODUCTION TO ENGINEERIN HYDROLOGY AND ITS APPLICATIONS**

**Part - A (Short Answer Questions)**

S No	QUESTIONS	Blooms Taxonomy Level	Course Outcome (CO)	Course Learning Outcome (CLO)
1	Draw the hydrological cycle. And label the different components.	Remember	CO 1	ACE014.01
2	What are the reasons for error in measurement of precipitation?	Understand	CO 1	ACE014.01
3	Define Readily available soil moisture in view of hydrology	Remember	CO 1	ACE014.01
4	How can we reduce the water usage? Give one example	Understand	CO 1	ACE014.01
5	What do mean by term 'Hydrology' in civil engineering	Remember	CO 1	ACE014.01
6	Write the applications of Hydrology and its importance.	Understand	CO 1	ACE014.01
7	Name the types of rain-gauges? How it works.	Remember	CO 1	ACE014.01
8	How will you select the site for rain gauge?	Understand	CO 1	ACE014.01
9	What do mean by catchment area? List different units.	Remember	CO 1	ACE014.02
10	Define permanent wilting point with neat sketch	Remember	CO 1	ACE014.02
11	Define rainfall double mass curve and draw the graph.	Understand	CO 1	ACE014.02
12	How will you calculate optimum number of rain gauge?	Remember	CO 1	ACE014.02
13	How can you measure the infiltration? Give its units	Remember	CO 1	ACE014.03
14	What is evapotranspiration and evaporation?	Remember	CO 1	ACE014.04
15	What is transpiration and process involve in it.	Understand	CO 1	ACE014.03
16	How will you consider the adjustment of record of rainfall data?	Understand	CO 1	ACE014.03
17	How will you measure flow in stream and rainfall?	Remember	CO 1	ACE014.03
18	Define Runoff? What are the types of Runoff	Remember	CO 1	ACE014.03
19	Name the methods used for measuring evapotranspiration.	Understand	CO 1	ACE014.03
20	What are infiltration indices? Give expressions.	Understand	CO 1	ACE014.01

**Part - B (Long Answer Questions)**

1	Explain the methods of estimating missing rainfall data at a station in a basin.	Remember	CO 1	ACE014.01
2	Explain step by step procedure you would adopt to prepare the depth- area duration curves for a particular storm for a basin having a number of rain-gauges, most of which are recording.	Understand	CO 1	ACE014.01
3	Explain the following in brief. Probable maximum precipitation Rain gauge density.	Understand	CO 1	ACE014.01
4	Discuss the analysis of rainfall data with respect to time, space, frequency and intensity.	Remember	CO 1	ACE014.03
5	Explain the balanced equation for precipitation.	Understand	CO 1	ACE014.02
6.	Describe the terms interception and Depression storage and explain it .	Understand	CO 1	ACE014.02
7.	Describe with the help of sketch various forms of soil moisture. Which of these soil moistures is mainly available for utilization by the plants?	Remember	CO 1	ACE014.03
8	Write short notes on: i. Double-mass curve ii. Cold and warm fronts iii. Cyclones and anticyclones.	Remember	CO 1	ACE014.03
9.	Write short notes on: i. Pan Co-efficient ii. $\phi$ -index iii. Evaporation opportunity.	Remember	CO 1	ACE014.04
10	Evaporation is indirectly a cooling process. Justify the statement. Discuss the factors affecting evaporation.	Remember	CO 1	ACE014.04
11	Discuss the various factors affecting evapotranspiration.	Understand	CO 1	ACE014.04
12	Distinguish between the potential evapotranspiration and the actual evapo-transpiration.	Understand	CO 1	ACE014.04

13	Bring out the difference between evaporation, transpiration, evapotranspiration and consumptive use.	Remember	CO 1	ACE014.04																												
14	Write notes on the following: (i). Permanent Wilting point (ii). Temporary Wilting point (iii). Readily available soil moisture.	Understand	CO 1	ACE014.04																												
<b>Part - C (Problem Solving and Critical Thinking Questions)</b>																																
1	A basin has the area in the form of a pentagon with each side of length 20Km. The five rain gauges located at the corners A, B, C, D and E have recorded 60, 81, 73, 59 and 45 mm of rainfall respectively. Compute average depth of rainfall over the basin using arithmetic mean and Thiessen polygon methods.	Understand	CO 1	ACE014.02																												
2	The annual rainfalls at 7 rain gauge stations in a basin are 58, 94, 60, 45, 20, 88 and 68cm respectively. What is the percentage accuracy of the existing network in the estimation of average depth of rainfall over the basin? How many additional gauges are required, if it is desired to limit the error to only 10%.	Understand	CO 1	ACE014.02																												
3	An outlet is to be designed for a town covering 25 km <sup>2</sup> , of which road area is 30%, residential area 40% and rest industrial area. The slope of the catchment is 0.004 and maximum length of the town measured in map is 3 km. From depth duration analysis the following information is obtained. <table border="1" style="margin-left: 20px;"> <tr> <td>Rainfall Duration(min)</td> <td>30</td> <td>45</td> <td>60</td> </tr> <tr> <td>Rainfall Depth(mm)</td> <td>15</td> <td>20</td> <td>30</td> </tr> </table> Calculate the peak discharge. The coefficients for road is 0.80, residential area 0.40 and industrial area is 0.20.	Rainfall Duration(min)	30	45	60	Rainfall Depth(mm)	15	20	30	Understand	CO 1	ACE014.02																				
Rainfall Duration(min)	30	45	60																													
Rainfall Depth(mm)	15	20	30																													
4	The ordinates of a 4-hour unit hydrograph are given below. Derive the ordinates of an 8-hour unit hydrograph by the S-curve method. <table border="1" style="margin-left: 20px;"> <tr> <td>Time (hr)</td> <td>4hr UGO(Cumec)</td> <td>Time (hr)</td> <td>4 hr UGO(Cumec)</td> </tr> <tr> <td>0</td> <td>0</td> <td>24</td> <td>103</td> </tr> <tr> <td>4</td> <td>24</td> <td>28</td> <td>64</td> </tr> <tr> <td>8</td> <td>82</td> <td>32</td> <td>36</td> </tr> <tr> <td>12</td> <td>159</td> <td>36</td> <td>17</td> </tr> <tr> <td>16</td> <td>184</td> <td>40</td> <td>6</td> </tr> <tr> <td>20</td> <td>151</td> <td>44</td> <td>0</td> </tr> </table>	Time (hr)	4hr UGO(Cumec)	Time (hr)	4 hr UGO(Cumec)	0	0	24	103	4	24	28	64	8	82	32	36	12	159	36	17	16	184	40	6	20	151	44	0	Understand	CO 1	ACE014.03
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16	184	40	6																													
20	151	44	0																													
5	The average rainfall over 45 ha of watershed for a particular storm was as follows: The volume of runoff from this storm was determined as 2.25 ha-m. Establish the $\phi$ -index. <table border="1" style="margin-left: 20px;"> <tr> <td>Time(h)</td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> </tr> <tr> <td>Rainfall (cm)</td> <td>0</td> <td>0.5</td> <td>1.0</td> <td>3.25</td> <td>2.5</td> <td>1.5</td> <td>0.5</td> </tr> </table>	Time(h)	0	1	2	3	4	5	6	Rainfall (cm)	0	0.5	1.0	3.25	2.5	1.5	0.5	Understand	CO 1	ACE014.03												
Time(h)	0	1	2	3	4	5	6																									
Rainfall (cm)	0	0.5	1.0	3.25	2.5	1.5	0.5																									
6	Cumulative rainfall during a storm are: <table border="1" style="margin-left: 20px;"> <tr> <td>Time(h)</td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> <td>7</td> <td>8</td> </tr> <tr> <td>Rainfall(cm)</td> <td>0</td> <td>7</td> <td>16</td> <td>22</td> <td>32</td> <td>40</td> <td>52</td> <td>68</td> <td>70</td> </tr> </table> Assume an initial abstraction loss of 10 mm and a constant infiltration loss rate of 5.0 mm/ h. Calculate the storm runoff volume from the catchment of 122 sq. km.	Time(h)	0	1	2	3	4	5	6	7	8	Rainfall(cm)	0	7	16	22	32	40	52	68	70	Understand	CO 1	ACE014.04								
Time(h)	0	1	2	3	4	5	6	7	8																							
Rainfall(cm)	0	7	16	22	32	40	52	68	70																							
7	The rate of rainfall for the successive 30 min period of a 3-hour storm is: 1.6, 3.6, 5.0, 2.8, 2.2, 1.0 cm/hr. The corresponding surface runoff is estimated to be 3.6 cm. Establish the $\phi$ -index. Also determine the W-index.	Understand	CO 1	ACE014.04																												

**UNIT- II**

**DISTRIBUTION OF RUNOFF**

**Part - A (Short Answer Questions)**

1	What is hydrograph analysis? List its uses	Remember	CO 2	ACE014.05
2	What do you mean by base flow? How it is different from surface flow?	Remember	CO 2	ACE014.05
3	What do you understand about flood hydrograph, draw neat sketch	Remember	CO 2	ACE014.05
4	Define return period and exceedance probability? Give expressions	Understand	CO 2	ACE014.05
5	Define Unit hydrograph, Why it is called as unit hydrograph?	Remember	CO 2	ACE014.06
6	Define S- hydrograph, how it different from unit hydrograph	Remember	CO 2	ACE014.06
7	Define Maximum probable flood, give its importance	Understand	CO 2	ACE014.06
8	What is Design flood? How it useful in design calculations	Understand	CO 2	ACE014.06
9	What do you mean by Annual series in hydrology?	Remember	CO 2	ACE014.07
10	What does it mean Partial series in hydrology?	Remember	CO 2	ACE014. 07
11	Write the formulae used to calculate unit hydrograph.	Understand	CO 2	ACE014. 07
12	Draw and define S-Hydrograph? How it is different from other hydrographs.	Remember	CO 2	ACE014. 07
13	Who introduced unit hydrograph theory? Emphasize its importance.	Remember	CO 2	ACE014. 07
14	Explain instantaneous hydrograph. How it is different from other hydrographs.	Understand	CO 2	ACE014. 07
15	What is recession time in the hydrograph curve mention in the graph	Remember	CO 2	ACE014.08
16	Write Dicken's formula for flood discharge. How this calculation is useful in practical application.	Remember	CO 2	ACE014.08
17	What is flood frequency? Give mathematical expression for it	Understand	CO 2	ACE014.08
18	What is basin lag? Show the basin lag hydrograph curve?	Understand	CO 2	ACE014.08
19	What are ungauged rivers? How their discharge is measured	Remember	CO 2	ACE014.09
20	What do mean by complex storm? Emphasize its importance	Remember	CO 2	ACE014.09

**Part - B (Long Answer Questions)**

1	Define unit hydrograph. What are the assumptions underlying the unit Hydrograph theory.	Remember	CO 2	ACE014.05
2	What does the word unit refer to in the unit hydrograph? Explain with sketches what do you understand by the principle of linearity and principle of time invariance in the unit hydrograph theory?	Understand	CO 2	ACE014.05
3	Describe how recession constants of direct runoff and base flow curves are obtained from a semi log arithmetic plot.	Remember	CO 2	ACE014.05
4	Describe with the help of neat sketches any three methods of	Remember	CO 2	ACE014.05
5	How is runoff estimated using Strange's tables and Barlow's tables	Understand	CO 2	ACE014.06
6.	What is Hydrograph? Draw a single peaked hydrograph and explain its components	Remember	CO 2	ACE014.06
7.	What do you understand by the principle of linearity and time invariance in unit hydrograph?	Remember	CO 2	ACE014.06
8	What are the applications of unit hydrograph?	Understand	CO 2	ACE014.07
9.	Explain the terms: (i). Recurrence interval (ii). Probable maximum precipitation.	Remember	CO 2	ACE014.07
10	What are the limitations of unit hydrograph or the assumptions made in the construction of hydrograph?	Understand	CO 2	ACE014.07
11	Explain in detail about synthetic unit hydrograph? With the aid of a neat sketch.	Understand	CO 2	ACE014.08

12	What are the uses of unit hydrograph? Explain the same in the estimation of the discharge of the stream.	Remember	CO 2	ACE014.08
13	Explain the terms: (i) Annual series (ii) Partial duration series	Understand	CO 2	ACE014.08
14	Describe how unit hydrograph can be used to predict the runoff from a storm.	Understand	CO 2	ACE014.08
15	List out and explain various physiographic factors affecting runoff in details with help of neat sketches.	Remember	CO 2	ACE014.09
16	What are the various components of runoff? Describe how each component is derived in the runoff process.	Understand	CO 2	ACE014.09
17	State the significance of inflection point on recession side of the hydrograph. Also explain the different factors that effect the shape of the hydrograph.	Understand	CO 2	ACE014.10
18	Describe the method of deriving unit hydrograph from complex storms.	Understand	CO 2	ACE014.10
19	Discuss a method to obtain UH from complex storms. Explain its step by step construction process	Understand	CO 2	ACE014.10
20	What do you mean by Antecedent precipitation index? Explain its application in the estimation process.	Understand	CO 2	ACE014.10

**Part - C (Problem Solving and Critical Thinking Questions)**

1	A drainage basin has the following characteristics. Basin area = 2500 sq. km. Length of the main stream $L = 110$ km. Distance from the centroid of the basin to outlet = 70 km. Construct the 4 hour synthetic unit hydrograph for the basin if $C_t = 1.50$ and $C_p = 0.6$	Understand	CO 2	ACE014.05																																										
2	A 4h hydrograph for a project site in Mahanadi Basin is given below. Calculate 2 - h UH by S-hydrograph approach. UH Ordinates in $m^3/sec$ . <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Time(h)</td> <td>0</td><td>2</td><td>4</td><td>6</td><td>8</td><td>10</td><td>12</td><td>14</td><td>16</td><td>18</td><td>20</td><td>22</td><td>24</td><td>26</td> </tr> <tr> <td>UH ordinates</td> <td>0</td><td>30</td><td>10</td><td>17</td><td>21</td><td>18</td><td>12</td><td>80</td><td>40</td><td>35</td><td>68</td><td>20</td><td>15</td><td>50</td> </tr> </table>	Time(h)	0	2	4	6	8	10	12	14	16	18	20	22	24	26	UH ordinates	0	30	10	17	21	18	12	80	40	35	68	20	15	50	Understand	CO 2	ACE014.05												
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3	For a river reach $K$ is 28 h and $X$ is 0.25. Route the following inflow hydrograph. Take $O_1 = I_1$ for the beginning step. Determine the values of attenuation and translation of the peak.	Understand	CO 2	ACE014.06																																										
4	Compute the runoff volume from a catchment of 120 Sq.km from the following data. Use Khoshla's method and assume that the area belong to Andhra Pradesh <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Months</td> <td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>June</td> </tr> <tr> <td>Rainfall</td> <td>8.5</td><td>10</td><td>6</td><td>50</td><td>34</td><td>150</td> </tr> <tr> <td>Temp <math>^{\circ}C</math></td> <td>24</td><td>26</td><td>35</td><td>38</td><td>36</td><td>32</td> </tr> <tr> <td>Months</td> <td>July</td><td>Aug</td><td>Sept</td><td>Oct</td><td>Nov</td><td>Dec</td> </tr> <tr> <td>Rainfall</td> <td>180</td><td>220</td><td>110</td><td>80</td><td>50</td><td>15</td> </tr> <tr> <td>Temp <math>^{\circ}C</math></td> <td>30</td><td>31</td><td>27</td><td>23</td><td>21</td><td>20</td> </tr> </table> Rainfall is in mm.	Months	Jan	Feb	Mar	Apr	May	June	Rainfall	8.5	10	6	50	34	150	Temp $^{\circ}C$	24	26	35	38	36	32	Months	July	Aug	Sept	Oct	Nov	Dec	Rainfall	180	220	110	80	50	15	Temp $^{\circ}C$	30	31	27	23	21	20	Understand	CO 2	ACE014.06
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5	The peak discharge and time to peak in a 3 h unit hydrograph derived for a basin of area 250 $km^2$ with $L = 30$ km and $L_c = 14$ km are $50m^3/s$ and 9 h respectively. Assuming that Snyder's synthetic unit hydrograph applies determine the coefficient $C_t$ and $C_p$ . Determine the 2 h unit hydrograph for the upper 180 $km^2$ of the same watershed which has $L = 20$ km and $L_c = 11.8$ km.	Understand	CO 2	ACE014.08																																										
6	A drainage basin has an area of 3800 $km^2$ . Base period of a 9-hour unit hydrograph from the following data: $L = 320$ km, $L_{ca} = 200$ km, $C_t = 0.9$ , $C_p = 4.0$ . Determine : Lag period and Peak discharge.	Understand	CO 2	ACE014.06																																										
7	A water shed of 3130 sq. km was subjected to a storm of 4 hr duration from which the following are recorded. UH Ordinates in $m^3/sec$ . <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Time(h)</td> <td>0</td><td>2</td><td>4</td><td>6</td><td>8</td><td>10</td><td>12</td><td>14</td><td>16</td><td>18</td><td>20</td><td>22</td><td>24</td> </tr> <tr> <td>UH ordinates</td> <td>0</td><td>30</td><td>110</td><td>170</td><td>210</td><td>180</td><td>120</td><td>80</td><td>40</td><td>35</td><td>20</td><td>15</td><td>5</td> </tr> </table>	Time(h)	0	2	4	6	8	10	12	14	16	18	20	22	24	UH ordinates	0	30	110	170	210	180	120	80	40	35	20	15	5	Understand	CO 2	ACE014.07														
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### UNIT-III

#### GROUND WATER OCCURRENCE

##### Part - A (Short Answer Questions)

1	Define aquifer, How aquifers are formed?	Understand	CO 3	ACE014.10
2	What are the different types of aquifers? Draw a neat sketch of the same.	Remember	CO 3	ACE014.10
3	Define porosity. Give the mathematical expression of the porosity.	Remember	CO 3	ACE014.10
4	Define Specific yield. Explain the term the equation	Remember	CO 3	ACE014.10
5	What is specific retention. How it is different from Specific yield?	Understand	CO 3	ACE014.10
6	Define Permeability. Give its dimensional formula	Remember	CO 3	ACE014.11
7	What do you mean by transmissibility? How it is different from permeability?	Remember	CO 3	ACE014.11
8	What is Storage coefficient? Write its mathematical expression	Understand	CO 3	ACE014.11
9	What are the types of wells? Draw Sectional view of the well	Remember	CO 3	ACE014.11
10	Ground water and surface water, Which water is more pure?	Remember	CO 3	ACE014.12

11	Define well development, Draw a neat sketch.	Understand	CO 3	ACE014.12
12	What do mean by well construction? List the stepwise construction process.	Remember	CO 3	ACE014.12
13	What is Darcy's law. Give its expression and application	Remember	CO 3	ACE014.13
14	Define aquitard and give the examples.	Understand	CO 3	ACE014.13
15	What is aquiclude and give the examples.	Understand	CO 3	ACE014.13
16	Define aquifuge and give the examples.	Remember	CO 3	ACE014.14
17	What are the different parameters considered in aquifer, name them?	Remember	CO 3	ACE014.14
18	What do you mean by unconfined aquifer? Draw its schematic figure	Understand	CO 3	ACE014.14
19	What do mean by radial flow .give an example	Understand	CO 3	ACE014.15
20	Which type of flow is generally considered in the aquifer? Justify.	Remember	CO 3	ACE014.15

##### Part – B (Long Answer Questions)

1	Write short notes on: Specific capacity of a well specific yield of an aquifer Aquifer and aquiclude	Remember	CO 3	ACE014.10
2	Distinguish between Groundwater and Perched groundwater.	Remember	CO 3	ACE014.10
3	Distinguish between Open wells and tube wells.	Remember	CO 3	ACE014.10
4	Distinguish between Water table and artesian aquifers.	Remember	CO 3	ACE014.11
5	Distinguish between Confined aquifer and water table aquifer	Understand	CO 3	ACE014.11
6	Write notes on the following: Spherical flow in a well, Interference among wells	Understand	CO 3	ACE014.11
7	Distinguish between Permeability and transmissibility. Explain them with the help of mathematical expressions	Remember	CO 3	ACE014.12
8	Differentiate between shallow dug wells and deep dug wells. How the dug well is constructed?	Remember	CO 3	ACE014.12
9	Enumerate the methods which are used for determining the yield of dug wells. Discuss briefly any one of these methods.	Understand	CO 3	ACE014.12
10	Distinguish with sketches if necessary, the difference between unconfined and confined aquifer	Remember	CO 3	ACE014.13

11	Derive a formula for discharge of a well in a homogeneous unconfined aquifer assuming equilibrium flow condition. State the assumptions on which the formula is based.	Remember	CO 3	ACE014.13																												
12	Distinguish between: Vadose zone and phreatic zone Explain them with the help of neat sketch	Understand	CO 3	ACE014.14																												
13	Define the terms: Transmissivity, storability and write their mathematical expressions and also explain the terms in it.	Remember	CO 3	ACE014.15																												
14	Define and explain the following terms as used in connection with ground water with neat sketches. Capillary fringe, Pellicular water, Field capacity.	Remember	CO 3	ACE014.15																												
15	Write a short note on the following with suitable examples Capillary water, Hygroscopic water Gravitational water	Understand	CO 3	ACE014.15																												
16	Define the terms: i) full supply coefficient ii) root zone depth. Explain them with the help of neat sketch	Remember	CO 3	ACE014.16																												
17	Explain in brief about the types of wells and their construction process involved in it.	Understand	CO 3	ACE014.16																												
18	Draw neat sketches of confined and unconfined aquifers. How one is different with the other.	Remember	CO 3	ACE014.17																												
19	Explain in details about the construction of wells? With the neat sketch and clearly label the different components of the well	Understand	CO 3	ACE014.17																												
20	Define: i) outlet factor ii) capacity factor and also briefly describe its applications.	Remember	CO 3	ACE014.17																												
<b>Part – C (Problem Solving and Critical Thinking)</b>																																
1	A Flood of 1000 cumec exceeded 60 times during a period of 30years. A flood of 3500 cumes exceeded twice. Determine the annual probability and average recurrence interval for both the floods	Understand	CO 3	ACE014.10																												
2	Design a tube well for the following data : Yield required = 0.2 cumec Thickness of confined aquifer =40 m Radius of circle of influence = 300m Permeability coefficient =80m/ day Drawdown= 6m	Understand	CO 3	ACE014.10																												
3	The following data are observed in a stream by a Price current meter? The current meter rating equation is given as $V = 0.33 + 0.03N$ m/sec. where N is No. of Revolutions per second. Calculate the river discharge	Understand	CO 3	ACE014.11																												
	<table border="1"> <tbody> <tr> <td>Distance from Bank (m)</td> <td>0</td> <td>3</td> <td>5</td> </tr> <tr> <td>Depth (m)</td> <td>0</td> <td>0.6</td> <td>1.2</td> </tr> <tr> <td>No. of Revolutions at 0.6d</td> <td>0</td> <td>184</td> <td>125</td> </tr> <tr> <td>Time Seconds</td> <td>0</td> <td>184</td> <td>125</td> </tr> <tr> <td>Distance from Bank (m)</td> <td>15</td> <td>18</td> <td>21</td> </tr> <tr> <td>No. of Revolutions at 0.6d</td> <td>115</td> <td>110</td> <td>95</td> </tr> <tr> <td>Time Seconds</td> <td>125</td> <td>125</td> <td>125</td> </tr> </tbody> </table>	Distance from Bank (m)	0	3	5	Depth (m)	0	0.6	1.2	No. of Revolutions at 0.6d	0	184	125	Time Seconds	0	184	125	Distance from Bank (m)	15	18	21	No. of Revolutions at 0.6d	115	110	95	Time Seconds	125	125	125			
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4	A well with a radius of 0.5m penetrates completely a confined aquifer of thickness 40 m and permeability 30m /day. The well is pumped so that the water level in the well remains at 7.5m below the original piezometric surface. Assuming that the radius of influence is 500m compute the steady state discharge from the well	Understand	CO 3	ACE014.11																												
5	A 20 cm well penetrates 30 m below static water level. After a long period of pumping at a rate of 1800 lpm, the drawdowns in the observation wells at 12 m and 36 m from the pumped well are 1.2 m and 0.5 m respectively. Determine the i. Transmissibility of the aquifer drawdown in the pumped well assuming radius of influence as 300m iii. Specific capacity of the well.	Understand	CO 3	ACE014.12																												



6	A tube well of 30m diameter penetrates fully in an artesian aquifer. The strainer length is 15 m. Calculate the yield from the well under a drawdown of 3 m. The aquifer consists of sand of effective size of 0.2 mm having coefficient of permeability equal to 50 m/day. Assume radius of influence is equal to 150 meters	Understand	CO 3	ACE014.12
7	A loam soil has field capacity of 22% and wilting coefficient of 10 %. The dry unit weight of soil is 1.5 g/cm <sup>3</sup> . If the root zone depth is 70 cm, determine the storage capacity of the soil. Irrigation water is applied if the moisture content falls to 14%. If the water application efficiency is 75 %, determine the water depth required to be applied in the field.	Understand	CO 3	ACE014.13
8	The CCA for a distributary is 15000 ha. The intensity of irrigation is 40% for rabi and 10% for rice. If kor period is 4 weeks for rabi and 2.5 weeks for rice, determine the outlet discharge. Outlet factor for rabi and rice may be assumed as 1800 ha /m <sup>3</sup> / sec and 775 ha /m <sup>3</sup> /sec. What is design discharge of distributary head at 10% conveyance	Understand	CO 3	ACE014.13
9	During a recuperation test, the water in an open well was depressed by pumping by 2.5 meters and it recuperated 1.8 meters in 0 minutes. Find i. Yield from a well of 4m diameter under a depression head of 3 meters, ii. The diameter of the well to yield 8 liters/second under a depression head of 2meters.	Understand	CO 3	ACE014.14
10	An unconfined aquifer has an area extent of 15km <sup>2</sup> . When 9.5 million cubic metres of water was pumped out, the water table was observed to go down by 2.4m. What is the specific yield of the aquifer? If the water table of the same aquifer rises by 12.5 m during a monsoon season, what is the volume of recharge?	Understand	CO 3	ACE014.15

#### UNIT-IV

### NECESSITY AND IMPORTANCE OF IRRIGATION

#### Part – A (Short Answer Questions)

1	Define Irrigation; Give the importance of Irrigation in India.	Remember	CO 4	ACE014.18
2	What are the different types of soils in Indian and their suitability?	Remember	CO 4	ACE014.18
3	What do you understand about full supply coefficient?	Understand	CO 4	ACE014.18
4	What are the ill effects of irrigation?	Understand	CO 4	ACE014.18
5	What standards required for Irrigation water?	Remember	CO 4	ACE014.19
6	Define Duty and Delta. State the relation between them.	Remember	CO 4	ACE014.19
7	What do you know about the water conveyance efficiency?	Understand	CO 4	ACE014.18
8	What do you understand about vertical distribution of soil moisture?	Remember	CO 4	ACE014.19
9	Define water logging? What are problems associated with this?	Understand	CO 4	ACE014.19
10	Define field capacity, discuss briefly its importance.	Understand	CO 4	ACE014.19
11	What is soil fertility? List the factors affects the soil fertility.	Understand	CO 4	ACE014.20
12	What do mean by irrigation efficiency? Give its expression.	Remember	CO 4	ACE014.20
13	What do you understand by the term 'Water Course'?	Understand	CO 4	ACE014.21
14	What is the type of soil present in India for irrigation?	Remember	CO 4	ACE014.21
15	What are the types of irrigations and name them?	Remember	CO 4	ACE014.21
16	What do mean by artificial irrigation .give an example	Understand	CO 4	ACE014.21
17	What do mean by natural irrigation .give an example	Understand	CO 4	ACE014.21
18	What is consumptive use? What is its importance in irrigation?	Remember	CO 4	ACE014.22
19	When do you consider the land for the crop rotation?	Remember	CO 4	ACE014.22
20	What is the formula used for finding depth of irrigation?	Remember	CO 4	ACE014.22

**Part – B (Long Answer Questions)**

1	Discuss various methods of irrigation and state the advantages of each method.	Remember	CO 4	ACE014.18
2	Describe the step by step procedure for preparation of land for irrigation	Understand	CO 4	ACE014.18
3	Discuss in brief, various methods of surface irrigation.	Remember	CO 4	ACE014.18
4	What is meant by C2-S2 water? Discuss its usefulness for irrigating fine textured soils.	Remember	CO 4	ACE014.18
5	Write short notes on: i. Applicability of lift irrigation ii. Mixed cropping	Understand	CO 4	ACE014.19
6	Explain in detail about the ill-effects of irrigation and brief about assessment of irrigation.	Remember	CO 4	ACE014.19
7	What is meant by `Border flooding' How does it differ from `Check flooding' and `free flooding'?	Understand	CO 4	ACE014.19
8	What is meant by Check flooding and also give a brief note of crop rotation.	Remember	CO 4	ACE014.19
9	What is meant by Furrow irrigation and Sprinkler irrigation? Which one is Preferred in India and Why.	Understand	CO 4	ACE014.19
10	Define Irrigation. What is the necessity of irrigation?	Remember	CO 4	ACE014.19
11	Describe in brief some of the important irrigation projects and multipurpose river valley projects under taken or completed after independence of our country.	Remember	CO 4	ACE014.19
12	Explain as how the following factors effect the duty of a crop. i. soil and sub soil condition ii. Stage of growth iii. Temperature iv. Rainfall	Understand	CO 4	ACE014.20
13	What is meant by flow duty and quantity duty? Explain the factors affecting the duty.	Remember	CO 4	ACE014.20
14	Define the terms Duty, Delta and base period and also derive the relation between them.	Remember	CO 4	ACE014.20
15	Explain the following terms: i. Field capacity ii. Moisture equivalent iii. Available moisture	Understand	CO 4	ACE014.20
16	Define irrigation efficiency. List out different types of irrigation efficiencies. Explain any two of them.	Remember	CO 4	ACE014.21
17	Define Consumptive use of water? List out various methods used for the assessment of consumptive use of water? Explain any one method in detail for the estimation of consumptive use	Remember	CO 4	ACE014.21
18	(a) Why soil is necessary for plant life. Explain the classification of soils based on geological process of formation.	Understand	CO 4	ACE014.21
19	Write down the classification of irrigation water based on sodium absorption ratio and its suitability for irrigation.	Remember	CO 4	ACE014.22
20	What is meant by duty and delta of canal water? Derive a relation between duty and delta for a given base period.	Understand	CO 4	ACE014.22

**Part – C (Problem Solving and Critical Thinking)**

1	<p>Find the storage capacity of soil from the following data: Field Capacity = 30%                      Wilting point = 14%                      Depth of Root zone = 1.20 m                      Dry Unit weight of soil = 1.7 g/cc</p> <p>Also determine the depth of water required in the field if irrigation water is supplied when the moisture content falls to 20% and the field application efficiency is 80%. If the conveyance losses in the water courses and field channels are 16% of the outlet discharge, calculate the depth of water needed at the canal outlet</p>	Remember	CO 4	ACE014.18
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2	What is the classification of irrigation water having the following characteristics? Concentration of Na, Ca and Mg are 22 ,3 and 2.5 milli-equivalents per liter respectively and the electrical conductivity is 200 micro mhos per cm at 250C ? What problems may rise in using this water on fine textured soils? What remedies do you suggest to overcome this trouble?	Understand	CO 4	ACE014.18																								
3	A watercourse has a culturable command area of 1200 ha. The intensity of irrigation for crop A is 40% and for B is 35%, both the crops being Rabi crops. Crop A has a kor period of 20 days and crop B has a kor period of 15 days. Calculate the discharge of the watercourse if the depth for crop A is 10 cm and for B is 16 cm.	Understand	CO 4	ACE014.18																								
4	An outlet has 600 ha, out of which only 75% is cultivable. The intensity of irrigation for Rabi and Kharif seasons are 70% and 30% respectively. Assuming losses in conveyance system as 10% of the outlet discharge, determine the discharge at the head of the irrigation channel. Take outlet discharge factor for Rabi season as 1500 ha/cumecs and for Kharif season as 750 ha/cumecs.	Understand	CO 4	ACE014.18																								
5	Determine the storage capacity of soil from the following data: Field Capacity = 30% Wilting point = 14% Depth of Root zone = 1.20 m Dry Unit weight of soil = 1.7 g/cc Also determine the depth of water required in the field if irrigation Water is supplied when the moisture content falls to 20% and the field application efficiency is 80%. If the conveyance losses in the water courses and field channels are 16% of the outlet discharge, Calculate the depth of water needed at the canal outlet.	Understand	CO 4	ACE014.19																								
6	After how many days the farmer should apply water to his field to ensure efficient use of irrigation water, if the field capacity is 27%, permanent wilting point is 14%, density of soil is 1500 kg/m <sup>3</sup> , effective root zone depth 0.75 m and daily consumptive use of water is 11 mm.	Understand	CO 4	ACE014.19																								
7	In a certain area paddy crop requires 14 cm of depth of water at an interval of 10 days for a base period of 110 days; Whereas wheat crop requires 9.0 cm of depth of water after 35 days with a base period of 140 days. Determine the delta of paddy crop and duty of wheat crop of that area.	Understand	CO 4	ACE014.19																								
8	800 m <sup>3</sup> of water is applied to a farmer's rice field of 0.6 hectares. When the moisture content in the soil falls to 40% of the available water between the field capacity of 36% of soil and permanent wilting point is 15% of the soil crop combination, determine the field application efficiency. The root zone depth of rice is 60cm. Assume porosity as 0.4.	Understand	CO 4	ACE014.20																								
9	The base period of Paddy is 120 days. If the duty for this is 900 hectares/cumecs. find the value of delta.	Understand	CO 4	ACE014.20																								
10	The base period, the intensity of irrigation and duty of various crops under a canal system are given in the table below. Find the reservoir capacity, if the canal losses are 23% and reservoir losses are 15 %.	Understand	CO 4	ACE014.20																								
<table border="1"> <thead> <tr> <th>Crop</th> <th>Base Period (days)</th> <th>Duty at the Field (ha/cumecs)</th> <th>Area Under the Crop</th> </tr> </thead> <tbody> <tr> <td>Wheat</td> <td>120</td> <td>1800</td> <td>4500</td> </tr> <tr> <td>Sugarcane</td> <td>360</td> <td>800</td> <td>5400</td> </tr> <tr> <td>Cotton</td> <td>200</td> <td>1400</td> <td>2200</td> </tr> <tr> <td>Rice</td> <td>120</td> <td>900</td> <td>2200</td> </tr> <tr> <td>Vegetables</td> <td>120</td> <td>700</td> <td>1800</td> </tr> </tbody> </table>					Crop	Base Period (days)	Duty at the Field (ha/cumecs)	Area Under the Crop	Wheat	120	1800	4500	Sugarcane	360	800	5400	Cotton	200	1400	2200	Rice	120	900	2200	Vegetables	120	700	1800
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**UNIT-V**

**CLASSIFICATION OF CANALS**

**Part - A (Short Answer Questions)**

1	What is the difference between the lake and a canal? Give examples	Understand	CO 5	ACE014.20
2	Name the two different types of silt theories? List their applications in hydrology.	Remember	CO 5	ACE014.20
3	What do you mean by initial and final regime of channels?	Remember	CO 5	ACE014.20
4	What are the merits of Lacey's theory? And how they are useful?	Understand	CO 5	ACE014.20
5	Why do we need to provide side slopes for canals? Justify your answer.	Remember	CO 5	ACE014.20
6	What do you understand about SCS curve? Give its application.	Understand	CO 5	ACE014.20
7	What is meant by depression storage? Draw a neat figure.	Remember	CO 5	ACE014.20
8	What do you know about Gumbels method of flood frequency analysis?	Understand	CO 5	ACE014.20
9	What is the difference between the silt and scour?	Understand	CO 5	ACE014.20
10	Which rational formula gives the best results for flood frequency analysis?	Remember	CO 5	ACE014.21
11	What is meant by detention storage?	Understand	CO 5	ACE014.21
12	What are the IS standards used for canal design? List any two assumptions associated with this.	Remember	CO 5	ACE014.21
13	Why is the stream gauging used? Brief its efficiency	Remember	CO 5	ACE014.21
14	What is Kennedy's theory? Write any assumptions made in this theory	Understand	CO 5	ACE014.22
15	What is Lacey's theory? List any assumptions made in this theory	Understand	CO 5	ACE014.22
16	What do you mean by canal? And different types of canals.	Remember	CO 5	ACE014.22
17	What do you mean by reservoir? What are the different applications of it?	Remember	CO 5	ACE014.22
18	What are the types of canals? And their merits and demerits	Remember	CO 5	ACE014.22
19	What is flood frequency? What are units of it in the estimation the same?	Understand	CO 5	ACE014.22
20	Name the methods used for design of irrigation canals. Which is most efficient?	Understand	CO 5	ACE014.22

**Part - B (Long Answer Questions)**

1	Write short notes on the following : free boarding in canals Permanent land width Inspection road Berm	Remember	CO 5	ACE014.20
2	Write down the classification of canals. Explain canal alignment	Understand	CO 5	ACE014.20
3	Write short notes on the following : i. Inspection road ii. Berm iii. regime channels	Remember	CO 5	ACE014.20
4	Why Lacey's conception is superior to that of Kennedy's?	Understand	CO 5	ACE014.20
5	What do you understand by Initial and final regime of channels?	Remember	CO 5	ACE014.20
6	When do you classify the channel as having attained regime condition?	Remember	CO 5	ACE014.20
7	Describe briefly the observations of Lacey on the regime of river.	Understand	CO 5	ACE014.20
8	Discuss critically the statement "The bank's of an unlined channel are more Susceptible to erosion than its bed, and hence the stability of the bank s and not of its bed is the governing factor in unlined canal designs".	Remember	CO 5	ACE014.20
9	Explain the following terms in detail. Ridge canal Side slope canal	Remember	CO 5	ACE014.21

10	What is the necessity of drainage below the lining? Discuss the various drainage and pressure release arrangements.	Understand	CO 5	ACE014.21
11	Using Lacey's basic regime equations derive an expression for Lacey's scour depth.	Remember	CO 5	ACE014.21
12	What is meant by scour? What precautions do you take against it during the design of weirs?	Understand	CO 5	ACE014.21
13	Explain the mid-section method of computing the discharge in a stream.	Remember	CO 5	ACE014.21
14	Show in a neat sketch, the positions of velocity measurements over the cross sectional area of the stream.	Understand	CO 5	ACE014.21
15	Draw a typical cross section of a barrage founded on pervious foundations and explain its salient features.	Remember	CO 5	ACE014.21
16	What are the methods of estimating design flood and what are their limitations?	Understand	CO 5	ACE014.21
17	What is balancing depth of cutting, Discuss in detail with aid of a neat sketch showing different components?	Remember	CO 5	ACE014.22
18	Distinguish between: Detention storage and depression storage Drainage density and drainage divide.	Understand	CO 5	ACE014.22
19	What do you understand by critical gradient? What will happen if the critical gradient is exceeded?	Understand	CO 5	ACE014.22
20	Distinguish between: Overland flow and interflow Influent and effluent streams	Remember	CO 5	ACE014.22
<b>Part – C (Problem Solving and Critical Thinking)</b>				
1	Design a trapezoidal shaped concrete lined channel to carry a discharge of 100 cumecs at a slope of 25 cm/ km. The side slopes of the channel are 1.5:1. The value of N may be taken as 0.016. Assume the limiting velocity as 1.5 m/sec	Understand	CO 5	ACE014.20
2	Design a trapezoidal shaped concrete lined channel to carry a discharge of 100 cumecs at a slope of 25 cm/km. The side slopes of the channel are 1.5:1. The value of N may be taken as 0.016. Assume the limiting velocity as 1.5m/sec.	Understand	CO 5	ACE014.20
3	Design an irrigation channel section for the following data. Discharge= 40 cumecs, Silt factor=1.0, Side slopes= ½: 1 Determine the longitudinal slope also	Understand	CO 5	ACE014.20
4	Design a channel section by Kennedy 's theory given the following data: Discharge Q =2828 cumecs Kutter 's N=0 .0225 Critical velocity ratio 'm' =1 Side slope = 1/2 : 1 B/ D = 7 .6 Find also the bed slope of the channel	Understand	CO 5	ACE014.20
5	Using Lacey's theory, design an irrigation channel for the following data. Discharge Q= 50 cumecs Silt factor 'f '=1 .0, Side slopes:1 /2 :1	Understand	CO 5	ACE014.21
6	Mean and standard deviation from annual peak of a river covering 80 years of data are 4100 m <sup>3</sup> /sec and 1600 m <sup>3</sup> /sec respectively. Using Gumbel's method, calculate the return period of the flood of 9100 m <sup>3</sup> /sec.	Understand	CO 5	ACE014.21

7	From the historical data of annual flood peaks of a catchment, the mean and standard deviation are estimated as 20000m <sup>3</sup> /s and 10000 m <sup>3</sup> /s. An existing structure on this catchment has been designed for 40000m <sup>3</sup> /sec. What could be its return period? Assume Gumbel's extreme value distribution with $n\sigma = 1.06$ and $n\gamma = 0.52$ .	Understand	CO 5	ACE014.21
8	From the analysis of available data on annual flood peaks of a small stream for a period of 35 years, the 50 year and 100 year flood have been estimated to be 660m <sup>3</sup> / sec and 740 m <sup>3</sup> / sec; using Gumbles method, estimate 200-year flood for the stream. Take $\sigma_n = 1.12847$ , $\gamma_n = 0.54034$ .	Understand	CO 5	ACE014.21
9	The slope of channel in alluvium is $S = 1/5000$ Lacey's silt factor=0.9. channel side slope= 1/2 :1 Find the channel section and maximum discharge, which can be allowed to flow in it	Understand	CO 5	ACE014.22
10	The following data has been obtained while gauging a stream. Main gauge reading (m) = 20.10 20.10 Auxiliary gauge reading (m) = 19.82 19.13 Discharge (cumecs) = 5.409.35 Calculate discharge when the main gauge is 20.10 m and Auxiliary gauge is 19.52 m.	Understand	CO 5	ACE014.22

**Prepared by:**

Ms. B Bhavani, Assistant Professor

**HOD, CE**